



NASA Procedural Requirements

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Subject: Appointment of Personnel To/From NASA

Responsible Office: Office of Human Capital Management

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Chapter 2. AST Rating Procedures

2.1. References

- 2.1.1. 5 CFR, Parts 332 and 337.
- 2.1.2. OPM Delegated Examining Agreement.

2.2. Introduction

This chapter describes qualifications and rating requirements for NASA's single agency Aerospace Technology (AST) standard. These requirements were initially developed during the period 1959 to 1961, concurrent with a classification survey conducted by NASA to satisfy NASA's need for its own unique and discrete specializations within its mission-oriented aerospace work. NASA engaged in discussions and negotiations with OPM in arriving at the requirements described below.

2.3. Basic Education Requirements

2.3.1. Applicants for AST positions must have successfully completed a standard professional curriculum at an accredited college or university leading to a bachelor's degree with major study in an appropriate field as specified in subparagraph 2.7 of this chapter. The term "successfully completed" means that the applicant must be within 9 months of completion of his/her bachelor's degree at the time of submission of the application; however, final appointment would be subject to completion of all degree requirements prior to entrance on duty.

2.3.2. The phrase "appropriate field" refers to engineering (not engineering technology), physical science, mathematics, life sciences, computer science, or other fields of science (see subparagraph 2.7 of this chapter). This excludes majors in the humanities or liberal arts. However, it may be appropriate to accept majors in social science, medical, or other fields if they are closely related to the duties of positions in the Life Sciences and Systems subgroup. In assessing applicants for entry-level (GS-7) positions based exclusively on education, there are limitations on the meaning of "appropriate field" for any given specialty; these limitations are described in detail in subparagraph 2.7 of this chapter. However, in assessing an applicant for a position at the GS-9 or above level, based on experience gained after receiving a degree, any of the undergraduate majors listed in the "academic major" column of the chart, following subparagraph 2.6.4 of this chapter, is acceptable if the applicant has at least 1 year of professional experience closely related to the specialty for which being rated. In such cases, prime consideration is given to the quality and level of experience.

2.3.3. An applicant who did not complete a standard professional curriculum leading to a bachelor's degree, as described above, may be determined to be eligible if he/she has obtained a graduate degree or has been admitted unconditionally to full graduate status in an appropriate field in an accredited institution, provided that at least an aggregate of 1 year of the applicant's study and/or professional experience has been closely related to the specialty field for which he/she is being rated.

2.4. Rating and Referral Process

2.4.1. Applications for AST positions will be evaluated independently by each NASA Center with delegated examining authority, using the established business processes of the NASA Staffing and Recruitment System (NASA STARS). Ratings will be assigned based on the relevance of the applicant's experience, training, and academic major.

2.4.2. Job analysis will be conducted to identify the major duties for which the appropriate skills and competencies for the candidate search are identified and incorporated into the search plan. Appropriate Subject Matter Experts will conduct the job analysis process in partnership with a human resources specialist.

2.4.3. There are five recommended competencies common to AST specialties that were developed by a NASA-wide group of Subject Matter Experts in accordance with the Uniform Guidelines on Employee Selection Procedures:

- a. Knowledge of engineering and/or science specialty area;
- b. Ability to identify problems, research and analyze information, and apply principles to find solutions;
- c. Ability to plan and organize work;
- d. Ability to communicate orally;
- e. Ability to communicate in writing.

2.4.4. The recommended competencies common to all AST specialties may be supplemented or amended with different competencies at local option. If different competencies are used, they must be developed using job analysis and at least one Subject Matter Expert in partnership with a human resources specialist.

2.4.5. Candidates will be referred in accordance with responsibilities identified in the Delegated Examining Agreement with the Office of Personnel Management, applicable laws in Title 5, United States Code, and regulations published in the Code of Federal Regulations.

2.5. Eligibility Requirements by Grade Level

2.5.1. All applicants must meet the basic education requirements described in Section 2.3 of this chapter. For entry-level (GS-7) positions for which applicants are rated solely on the basis of education, the applicant's education must meet the academic major and coursework requirements corresponding to the position's subgroup and specialty, as defined in subparagraph 2.7 of this chapter. Those specific major and coursework requirements are not mandatory, however, in rating applicants for positions at the GS-9 or higher level if they have at least 1 year of professional experience (gained after meeting the basic education requirements) that is closely related to the specialty for which being rated. In such cases, it is desirable, but not mandatory, that the applicant meet the major and coursework requirements for the AST specialty, as defined in subparagraph 2.7. At these grade levels, prime consideration should be given to the quality and level of experience.

2.5.2. Applicants must possess the necessary length and quality of professional experience and/or education to qualify for the grade level he/she will accept.

2.5.2.1. Requirements for GS-7.

- a. Applicants must meet the basic education requirements with the major field of study in one of the disciplines identified under "Academic Major" in the charts in Section 2.6, corresponding to the AST specialty/subgroup of the position for which being rated.
- b. In addition to the basic education requirements, applicants must have the following:
 1. One year of appropriate professional experience that has positively demonstrated ability or aptitude to do aerospace research, development design, operations, or closely related functions in one of the NASA technological specialties.
 2. Successfully completed 1 full academic year of graduate study in an appropriate field in an accredited institution.
 3. Any equivalent combination of experience and graduate study. Applicants not meeting (1), (2), or (3) may qualify for GS-7 if they meet any of the criteria outlined below.

2.5.2.2. Special Provisions for GS-7.

- a. Applicants may qualify at the GS-7 level if they meet any of the following criteria:
 1. Are in the upper third of their class, based on completed college work at the time of filing an application. This is the upper third of the class in the college or university or major subdivision (e.g., school of engineering).
 2. Have an average of 2.90 or better on a 4.0 scale for either all completed college work at time of application or all college courses completed during the last 2 years of the undergraduate curriculum.
 3. Have achieved a grade average of B+ (3.5 on a 4.0 scale) or better in the major field of study where such field is fully qualifying. This is either the average of all completed college work in the major field of study at time of application or the average of all college courses completed in the major field of study during the last 2 years of the undergraduate curriculum. (Senior students may be rated provisionally eligible under one of those criteria provided they had the required average in the junior year. They will be required to submit evidence at the time of appointment that the required average was maintained during the senior year.)
 4. Have been elected to membership in one of the national honorary scholastic societies meeting the minimum requirements of the Association of College Honor Societies (other than freshman honor societies).
 5. Have completed 12 months of student trainee experience (does not include periods of leave without pay) that includes at least one work period (2 months or 320 hours) equivalent to GS-5 or at least 15 months of appropriate student trainee experience which includes one work period equivalent to the GS-4 level.
 6. For engineering positions -- Successful completion of a 5-year program of study (e.g., one designed to be completed in no less than 5 years) or at least 160 semester hours leading to a bachelor's degree in an accredited college or university.
 7. For engineering positions -- If they have a professional engineering degree, up to
 8. 12 months of appropriate experience gained as a technician or technologist equivalent to the GS-5 or higher level may be credited as qualifying for GS-7.
 9. Have successfully completed all requirements for two bachelor's degrees, one in an appropriate field of science or engineering.
 10. Have 6 months aggregate of specialized experience or training, including 3 months gained after the junior year, in a subprofessional, semiprofessional, or technician status, which may have been obtained in a laboratory or elsewhere during a summer period, or assisting a professor, or on active military duty. This may have been on a part-time or intermittent basis, may have been paid or unpaid, and must have been appropriate for NASA technological work.
 11. Have received honors or elective positions indicating superior leadership other than scholastic, provided the applicant's academic standing was in the upper half of the graduating class.
 12. Have established a pattern of completing courses having unusual preparatory value or direct relation to the particular aerospace specialty for which they are being considered.
 13. Have creative research aptitude or special talent for NASA scientific or engineering work, shown by evidence obtained and documented by NASA by means of certifications from college professors or officials, or standardized questionnaires, or similar techniques.
- b. Criteria (1) through (7) above apply only to positions in NASA. These criteria support the provision in the National Aeronautics and Space Act of 1958, as amended, which authorizes NASA to establish entrance grades two grades higher than other agencies for certain scientific and engineering personnel. Raters should identify in the automated case file the criteria on which GS-7 eligibility is based.

2.5.2.3. Requirements for GS-9.

In addition to the basic education requirements, applicants must have at least one of the following:

1. One year of professional experience in an appropriate field at least equivalent in difficulty and responsibility to GS-7 level work in the Federal service.
2. Completion of all requirements for a master's or equivalent graduate degree in an appropriate field.
3. Completion of 2 full academic years of graduate education in an appropriate field.
4. An equivalent combination of experience and graduate study as discussed in (1) and (3) above.

2.5.2.4. Requirements for GS-11.

In addition to the basic education requirements, applicants must have at least one of the following:

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1. One year of professional experience in an appropriate field at least equivalent in difficulty and responsibility to GS-9 level work in the Federal service.
2. Completion of all requirements for a doctoral degree (Ph.D. or equivalent) in an appropriate field.
3. Completion of 3 full academic years of graduate education in an appropriate field.
4. For some research positions only, completion of all requirements for a master's or equivalent graduate degree in an appropriate field.
5. An equivalent combination of experience and graduate education as discussed in (1) and (3) above.

2.5.2.5. For GS-12 through GS-15.

- a. In addition to the basic education requirements, applicants must have:
 1. One year of professional experience in an appropriate field at least equivalent in difficulty and responsibility to that of the next lower grade in the Federal service.
 2. For some GS-12 research positions only, completion of all requirements for doctoral degree (Ph.D. or equivalent) in an appropriate field.
- b. For all grades, qualifying experience may be either paid or volunteer experience.
- c. Time spent in military service may be credited as an extension of experience gained immediately prior to entering the service, or it may be credited on its own merits, whichever is more favorable.
- d. Positive evidence of highly creative or outstanding research, e.g., development of a basic principle, concept method, approach, or technique which opened the way for major advances in the field, may result in eligibility at one grade higher than that for which the applicant would normally be rated. This principle does not apply if the applicant is eligible on the basis of graduate study.

2.5.2.6. Competencies common to all AST specialties.

- a. Applicants who meet the basic requirements will be evaluated further on the basis of their possession of competencies relevant to the position.
- b. There are five recommended competencies common to AST specialties:
 1. Knowledge of engineering and/or science specialty area.
 2. Ability to identify problems, research and analyze information, and apply principles to find solutions.
 3. Ability to plan and organize work.
 4. Ability to communicate orally.
 5. Ability to communicate in writing.
- c. These competencies were developed by a NASA-wide group of Subject Matter Experts in accordance with the Uniform Guidelines on Employee Selection Procedures.
- d. The recommended competencies common to all AST specialties may be supplemented or amended with different competencies at local option. If different competencies are used, they must be developed using job analysis and at least one Subject Matter Expert.

2.6. Field of Study Applicable to AST Subgroups and Specialties.

2.6.1. For entry-level GS-7 positions in which the candidate is qualifying based on education alone, the undergraduate college majors in the left column ("Academic Major") of the charts following subparagraph 2.6.4. will satisfy the minimum education requirement for the corresponding AST subgroups, provided any applicable special provisions identified in the explanatory material accompanying the chart are met. These special provisions are described in the pages immediately following the chart.

2.6.2. In determining the appropriateness of an individual degree program to the NASA subgroups, raters must not rely on degree titles alone, since there are no standard titling practices among colleges and universities. The degree titles shown represent the degree titles normally used. Raters, however, must use judgment and discretion when either a particular degree title or particular degree course content does not fit the norm.

2.6.3. One degree title that needs close course content review is the bachelor's degree in computer science. A number of schools are using this title for essentially business-oriented degrees. To qualify for AST positions, the computer science curriculum must have included (or be supplemented by) 30 semester hours of course work in a combination of mathematics, statistics, and computer science that provided in-depth knowledge of the following:

(1) Theoretical foundations and practical applications of computer science, including digital computer system architecture and system software organization, the representation and transformation of information structures, and the theoretical models for such representations and transformations.

(2) Essential mathematical and statistical techniques. At least 15 of the 30 semester hours must be in any combination of statistics and mathematics that include differential and integral calculus. Candidates must also meet one of the special provisions or additional experience requirements for GS-7.

2.6.4. Applicants being considered for an AST position at grade GS-9 or above based on experience gained after meeting the basic education requirements, must have majored in one of the academic disciplines identified on the chart (under "Academic Major") on the following pages. However, when rating an applicant on the basis of directly related experience, it is not mandatory that the applicant also meet the academic major and/or coursework requirements corresponding to the specific AST subgroup/specialty when qualifying on the basis of directly related experience. In these cases, prime consideration should be given to the quality and level of experience.

EDUCATION REQUIREMENTS FOR AST SUBGROUPS and SPECIALTIES

ACADEMIC MAJOR	Space Sciences 701-XX	Earth Sciences 702-XX	Life Sciences & Systems 709-XX	Fluid & Flight Mech 710-XX	Materials & Struct 715-XX	Propulsion & Power 720-XX	Flight Systems 725-XX	Measurement & Inst Sys 730-XX	Data Sys & Analysis 735-XX	Facilities 740-XX	Opns 745-XX	Mgt 730-XX
Aeronautical Eng Aeronautics Aerospace Eng Architecture	X	Xa Xa Xa	See specific req'mts	X X X	X X X	X X X	X X X	X X X	Xbc Xbc Xbc	X X X	X X X	X X X
Astronautical Eng Astronautics Astronomy Astrophysics	X X Xa Xa	Xa Xa Xa Xa	See specific req'mts	X X Xa X	X X	Xb X	X X	X X Xa X	Xbc Xbc Xbc Xbc	X Xa	X Xa	X X Xab X
Biomedical Eng Ceramic Eng Ceramics Chemical Eng		Xa Xa Xa Xa	See specific req'mts		Xa Xa X		X Xa Xa Xa	Xa Xbc Xbc X	Xbc Xbc Xbc Xbc	Xa X X X	Xa X X X	X X X X
Chemistry Civil Eng *Computer Science Computer Eng		Xa Xa Xa Xa	See specific req'mts		X Xb Xb Xb	X	Xa Xa Xa	Xa Xa Xa	Xbc Xbc Xbc X			X X Xab Xab
Earth & Planetary Sci Electrical Eng Electronic Eng	X X X	Xa Xa Xa	See specific req'mts	Xc X		Xa Xa	Xa Xa	Xb X X	Xbc Xbc Xbc	X X X	X X X	Xab X X
Geology Geophysics Industrial Eng Materials Eng	Xa Xa	Xa Xa Xa	See specific req'mts		Xb X		Xb X		Xbc Xbc Xbc Xbc	Xa X X X	Xa X X X	Xab X X X

Description of footnotes a, b, c, and d are found in section 2.7.

* See discussion in Section 2.6.3 regarding Computer Science as a qualifying major

EDUCATION REQUIREMENTS FOR AST SUBGROUPS and SPECIALTIES

ACADEMIC MAJOR	Space Sciences 701-XX	Earth Sciences 702-XX	Life Sciences & Systems 709-XX	Fluid & Flight Mech 710-XX	Materials & Struct 715-XX	Propulsion & Power 720-XX	Flight Systems 725-XX	Measurement & Inst Sys 730-XX	Data Sys & Analysis 735-XX	Facilities 740-XX	Opns 745-XX	Mgt 770-XX
Materials Science Math, Applied Math, Pure Mechanics, Applied	Xa Xa	Xa Xa Xa Xa	See specific req'mts	Xb Xa X	X Xd X	Xa Xb X	X Xa Xa X	Xa Xa X	Xbc Xc Xac Xbc	Xa Xa Xa X	Xa Xa Xa X	Xb Xa Xa X
Mechanics, Eng Mechanical Eng Metallurgical Eng Metallurgy		Xa Xa Xa Xa	See specific req'mts	X X	X X Xc Xc	X X	X X X X	X X	Xbc Xbc Xbc Xbc	X X X Xa	X X X Xa	X X Xb Xb
Meteorology Nuclear Eng Nuclear Eng Physics	Xa	Xa Xa Xa	See specific req'mts	X X	Xd X	X X	X X	X X	Xbc Xbc Xbc	X X	X X	X X X
Oceanography Optical Eng	Xa X	Xa Xa	See specific req'mts					Xa X	Xbc Xbc	X	X	Xab X
Physics Physics, Applied Physics, Eng	Xa Xa X	Xa Xa Xa	See specific req'mts	X X X	X X X	X X X	X X X	X X X	Xbc Xbc Xbc	Xa Xa Xa	Xa Xa Xa	X X X
Space Science Structural Eng	X	Xa Xa	See specific req'mts		X		X		Xbc Xbc	X	X	Xab X
Welding Eng			See specific req'mts		X		X		Xbc	X	X	Xb
Other Appropriate Physical Science or Engineering Field	Xa	Xa	See specific req'mts	Xa, b, or c	Xa,b,c,or d	Xa or b	Xa	Xab	Xbc	Xa	Xa	Xab

Description of footnotes a, b, c, and d are found in section 2.7.

2.7. Specific Education Requirements For AST Subgroups And Specialties

2.7.1. In rating applicants for GS-7 level positions, based on education alone, the undergraduate college majors in the left column ("Academic

Major") or the chart following subparagraph 2.6.4. are qualifying if marked with an "X" in the subgroup column. For example, a degree in aerospace engineering meets the education requirements for a position classified in the Space Science (701-XX) subgroup.

2.7.2. If the letter "X" is joined with a second letter ("a", "b", "c", or "d"), then additional coursework is required to meet the education requirements. The specific requirements are defined under the AST subgroup discussions below. For example, a degree in astronomy meets the education requirements for a position classified in the Space Sciences (701-XX) subgroup only if the curriculum includes or is supplemented by one physics or engineering lab in: electronics, optics, materials, vibration, high vacuum theory, heat transfer, or comparable field relating to aerospace instrumentation.

2.7.3. If the letter "X" is joined with multiple second letters (e.g. "Xab" or "Xbc"), the major must be supplemented by the additional coursework requirements described in both paragraphs corresponding to those letters. In other words, interpret "ab" as "a and b"--not "a or b."

2.7.4. Do not rely exclusively on the chart in rating applicants for AST positions: it is important that you first read through the special subgroup explanatory notes.

Space Sciences (701-XX)

- a. Majors annotated with "Xa" are qualifying if the curriculum includes or is supplemented by one physics or engineering lab in: electronics, optics, materials, vibration, high-vacuum theory, heat transfer, or comparable field relating to aerospace instrumentation.

Earth Sciences (702-XX)

- b. Majors annotated with "Xa" are qualifying if the curriculum includes or is supplemented by 6 semester hours or the equivalent in appropriate life sciences or other natural science courses and includes, or is supplemented by, at least two courses that would provide knowledge of such subjects (as appropriate to the vacancy) as the following:

advanced data analysis	geography
methodology	
aerospace instrumentation	geology
aeronomy	geodynamics
agriculture	geophysics
agronomy	hydrology
atmospheric physics	in situ sensing techniques
atmospheric chemistry	land use management
astronomy	marine resources
biology	mathematics
computer programming	meteorology
computer simulation	numerical analysis
earth resources	oceanography
earth sciences	optical and radar scanners
electromagnetic radiation	optics
engineering	radiative transfer
forestry	remote sensing techniques
forestry and agriculture	spectroscopy
geodesy	statistics

Life Sciences & Systems (709-XX)

Candidates must meet either of the following appropriate college majors and supplemental coursework requirements:

- a. Major study in biology (botany, zoology, biophysics, radiation biology, biochemistry, microbiology, physiology, toxicology) or in behavioral science (experimental, physiological, or clinical psychology); or other field of life sciences appropriate for one of these specialties, including or supplemented by at least 20 semester hours of physical science or engineering (undergraduate or graduate); or experience sufficient to provide a basis for understanding, use, and interpretation of the highly specialized ground-based or in flight measurement, environmental control, vehicle control, and other equipment required for crewed or organism-bearing aerospace flights and voyages; or
- b. Major study in engineering or physical science appropriate for one of these specialties, including or supplemented by, at least 20 semester hours of physiology; experimental or physiological psychology; or other appropriate life sciences; or experience in biotechnology, human factors engineering, or other appropriate life sciences field.

Fluid & Flight Mechanics (710-XX)

- a. Majors annotated with "Xa" are qualifying if the curriculum includes or is supplemented by 12 semester hours (or the equivalent) of appropriate physical science or engineering courses.
- b. Majors annotated with "Xb" are qualifying if the curriculum includes or is supplemented by 9 semester hours (or the equivalent) of physics, thermodynamics, fluid dynamics, or gas dynamics.
- c. A major in electrical engineering is not qualifying if the major is in production, transmission, and use of large-scale industrial power.

Materials and Structures (715-XX)

- a. Majors annotated with "Xa" are qualifying if they include or are supplemented by
- b. 12 semester hours (or the equivalent) in refractory ceramics, cermets, or protective coatings.
- c. Majors annotated with "Xb" are qualifying if they include or are supplemented by
- d. 12 semester hours (or the equivalent) in strength of materials, structures, thermodynamics, and/or basic static and dynamics.
- e. Majors annotated with "Xc" are qualifying if they include or are supplemented by
- f. 12 semester hours (or the equivalent) in physical or adaptive metallurgy, high-temperature metals and alloys, or cermets.

9. Majors annotated with "Xd" are qualifying if they include or are supplemented by 9 semester hours (or the equivalent) in physics, structures, materials, or other appropriate courses.

Propulsion and Power (720-XX)

- a. Majors annotated with "Xa" are qualifying if they include or are supplemented by one course in thermodynamics, nuclear physics, rocket propulsion fundamentals, gas dynamics, or modern or molecular physics.
- b. Majors annotated with "Xb" are qualifying if they include or are supplemented by 9 semester hours (or the equivalent) in physics, thermodynamics, chemistry, or closely related fields.

Flight Systems (725-XX)

- a. a. Majors annotated by "Xa" are qualifying if they include or are supplemented by 9 semester hours (or the equivalent) in machine design, mechanics, hydraulics, dynamics, thermodynamics, mechanical design, or mechanical measurement.
- b. b. The following education requirements apply to **Reliability and Quality Assurance (725-04)**, **Reliability (725-05)**, **Flight Systems Safety (725-11)**, **Quality Assurance (725-22)**, and **Safety and Mission Assurance (725-40)**.
- c. **Qualifying major:** A bachelor's degree with a major in any of the following disciplines is qualifying: aeronautical engineering, aerospace engineering, applied mechanics, astronautical engineering, biomedical engineering, ceramic engineering, chemical engineering, civil engineering, computer engineering, electrical or electronic engineering, engineering mechanics, engineering physics, industrial engineering, manufacturing engineering, materials engineering, mechanical engineering, metallurgical engineering, nuclear engineering, nuclear engineering physics, systems engineering, systems and control engineering, structural engineering, or welding engineering. Also, the disciplines of quality engineering, reliability engineering, and safety engineering are qualifying if the graduate's engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology.

Qualifying major with specific coursework: A bachelor's degree with a major in any of the following disciplines is qualifying provided it includes or is supplemented by 18 semester hours (or equivalent) in the courses listed below with 15 of those semester hours in the asterisked subjects: aeronautics, applied mathematics, applied physics, astronautics, ceramics, chemistry, computer science, fire protection engineering, materials science, metallurgy, oceanography, physics, or safety science. Also, the disciplines of quality engineering, reliability engineering, and safety engineering are qualifying (in conjunction with the specified coursework) if the graduate's engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology.

Coursework

Aeronautics	*Mechanics/Mechanics of materials
Antennas & propagation	*Occupational safety/Industrial safety
Chemistry	*Physics
Communication theory	Quality assurance/Quality engineering
*Computer science	Reliability
Digital design	Risk management
*Dynamics	Safety engineering
*Electrical engineering fundamentals	*Statics
*Electromagnetic theory	*Statistics
*Electronics	*Strength of Materials
Fire protection	*Structures
*Fluids	*Systems safety
*Human factors/Human engineering	*Systems engineering
*Manufacturing engineering	*Thermodynamics
*Materials	

In determining whether coursework is qualifying, raters should ensure that the coursework reflects a breadth of knowledge rather than being concentrated in one discipline and is not in the specific field in which the degree was obtained; e.g., courses in physics may not be used to qualify an individual who majored in physics.

Measurement and Instrumentation Systems (730-00)

- a. Majors annotated by "Xa" are qualifying if they include or are supplemented by two courses in solid state physics, materials, optics, statics and dynamics, electricity and electronics, electron optics, kinetic theory of gases, electromagnetic propagation or radiation, semiconductors, vibration, information theory, or heat transfer.
- b. A major in electrical engineering is qualifying, unless it is in production, transmission, and use of large-scale industrial electrical power.

Data Systems and Analysis (735-00)

- a. Majors annotated with "a" after the "X" must include or be supplemented by
- b. 12 semester hours (or the equivalent) in appropriate physical science or engineering courses (not required for data analysis or computer research and development positions).
- c. Majors annotated with "b" after the "X" must include or be supplemented by
- d. 6 semester hours (or the equivalent) in mathematics beyond basic calculus (i.e., any mathematics course in which basic calculus is listed as a prerequisite).
- e. Majors annotated with "c" after the "X" must include or be supplemented by at least two of the following courses for the indicated specialties:

Data Analysis (735-05) and Computer Research and Development (735-16)

compiler construction	mathematical statistics (if 6 semester hour course)
computer graphics	numerical methods/numerical analysis)

computer architecture	operating systems
computer networks	programming languages
data base management	software engineering
data structures	theory of equations
differential equations	theory of computation
linear algebra	

Data Systems (735-02), Software Systems (735-03), Data Systems Analysis (735-06), Data Hardware Systems (735-13), and Theoretical Simulation Techniques (735-16)

communication theory	electronics
computer organization	logic design
control systems	optics (for simulation)
electricity and magnetism	solid state physics (for transistors and tapes)
electrical networks	

Facilities (740-XX).

- a. Majors annotated with "Xa" are qualifying if they include or are supplemented by
- b. 12 semester hours (or the equivalent) in appropriate physical science or engineering courses.

The education requirements for the Facilities Systems Safety (740-03) Specialty are:

Qualifying major: A bachelor's degree with a major in any of the following disciplines is qualifying: aeronautical engineering, aerospace engineering, applied mechanics, astronautical engineering, biomedical engineering, ceramic engineering, chemical engineering, civil engineering, computer engineering, electrical or electronic engineering, engineering mechanics, engineering physics, industrial engineering, manufacturing engineering, materials engineering, mechanical engineering, metallurgical engineering, nuclear engineering, nuclear engineering physics, systems engineering, systems and control engineering, structural engineering, or welding engineering. Also, the disciplines of quality engineering, reliability engineering, and safety engineering are qualifying if the graduate's engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology.

Qualifying major with specific coursework: A bachelor's degree with a major in any of the following disciplines is qualifying provided it includes or is supplemented by 18 semester hours (or equivalent) in the courses listed below with 15 of those semester hours in the asterisked subjects: aeronautics, applied mathematics, applied physics, astronautics, ceramics, chemistry, computer science, environmental engineering, fire protection engineering, materials science, metallurgy, oceanography, physics, safety science. Also, the disciplines of quality engineering, reliability engineering, and safety engineering are qualifying (in conjunction with the specified coursework) if the graduate's engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology.

Aeronautics	*Mechanics/mechanics of materials
Antennas & propagation	*Occupational safety/Industrial safety
Chemistry	*Physics
Communication theory	Quality assurance/Quality engineering
*Computer science	Reliability
Digital design	Risk management
*Dynamics	Safety engineering
*Electrical engineering fundamentals	*Statics
*Electromagnetic theory	*Statistics
*Electronics	*Strength of materials
Fire protection	*Structures
*Fluids	*Systems safety
*Human factors/human engineering	*Systems engineering
*Manufacturing engineering	*Thermodynamics
*Materials	

In determining whether coursework is qualifying, raters should ensure that the coursework reflects a breadth of knowledge rather than being concentrated in one discipline and is not in the specific field in which the degree was obtained; e.g., courses in physics may not be used to qualify an individual who majored in Physics.

Operations (745-XX).

- a. Majors annotated with "Xa" are qualifying if they include or are supplemented by 12 semester hours (or the equivalent) in appropriate physical science or engineering courses.
- b. For Research Pilot (745-10) positions GS-9 through GS-15, appropriate college majors include any of the majors listed in this appendix or under Life Sciences and Systems. In addition to the basic education requirements, candidates must have a current Federal Aviation Administration commercial pilot's license with instrument rating or a pilot and instrument rating from the armed services. One, or a

combination of, the following criteria must also be met:

For GS-9:

1. A minimum of 900 hours of pilot-in-command (or first pilot) flight time that includes at least 500 hours in jet aircraft having at least 3,000 pounds of thrust per engine; or
2. One year of research piloting experience.

For GS-11:

1. A minimum of 1,000 hours of pilot-in-command (or first pilot) flight time that includes at least 500 hours in jet aircraft having at least 3,000 pounds of thrust per engine; or
2. One year of research piloting experience which must have been equivalent to grade GS-9.

For GS-12/15:

1. A minimum of 1,500 hours of pilot-in-command (or first pilot) flight time that included at least 500 hours in jet aircraft having at least 3,000 pounds of thrust per engine; plus 1 year of research piloting experience equivalent to the next lower grade in the Federal service; or 1 year of research piloting experience equivalent to the next lower grade.
2. For positions whose principal duties involve research and development of experimental rotorcraft, pilot-in-command (or first pilot) flight time in aircraft powered by engines having a total of 1,000 horsepower or more in lieu of flight time in jet aircraft may be substituted at all grades.

Management (770-00)

- a. Majors annotated by "a" after the "X" must include or be supplemented by 12 semester hours (or the equivalent) in appropriate physical science or engineering courses;
- b. Majors annotated by "b" after the "X" must include or be supplemented by mathematics through, and including, the integral calculus level.

Note: In filling positions in the AST, Life Sciences Program Management specialty, the qualification requirements are those shown under NASA Class Code (NCC) 709, Life Sciences and Systems.

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